Simulations of Long-Term Drought in the United States Great Plains

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The United States Great Plains experienced a number of major droughts during the last century. The 1930s drought was the most severe, lasting for almost a decade, and affecting about 2/3 of the country and parts of Canada. A second major drought occurred during the 1950s. In this study, we present recent progress in understanding the nature of these multi-year droughts in the Great Plains and provide some insight into their predictability. The results are based on an ensemble of nine 70-year (1930-1999) simulations carried out with the NASA Seasonal-to-Interannual Prediction Project (NSIPP-1) atmospheric-land general circulation model (AGCM) run at a horizontal resolution of 2° latitude by 2.5° longitude, and forced by observed sea surface temperatures (SSTs).

Time series (not shown) of the simulated Great Plains precipitation indicate that the model does tend to produce dry conditions during the 1930s (though not during the 1950s). Figure 1 shows the correlation between the ensemble-mean low pass filtered (time scales greater than 6 years) Great Plains precipitation and the SST at all points. The correlations, with a sign change to emphasize the connection with dry conditions over the Great Plains (lower panel), show a large-scale coherent structure that has some similarity to the cold phase of an El Nino/Southern Oscillation (ENSO) event. Reduced precipitation in the Great Plains on these long time scales is associated with negative SST anomalies throughout the central tropical Pacific Ocean, extending northward toward the west coast of North America. The negative SST anomalies are flanked by positive anomalies that extend poleward and eastward from the western tropical Pacific. The upper panel of Figure 1 shows the correlation between the ensemble-mean filtered Great Plains precipitation and the filtered ensemble-mean 200mb height field at all points. The correlations show that Great Plains precipitation is associated with global-scale height anomalies. Dry conditions are associated with positive height anomalies in the middle latitudes of both hemispheres, and reduced heights in the tropics and the high latitudes. We note that the zonally-symmetric structure of the height anomalies found here is similar to that found on interannual time scales during northern summer (Schubert et al. 2001).

References

Schubert, S.D., M.J. Suarez, P.J. Pegion, M.A. Kistler, and A. Kumar, 2001: Predictability of zonal means during boreal summer. To appear in J. Climate.

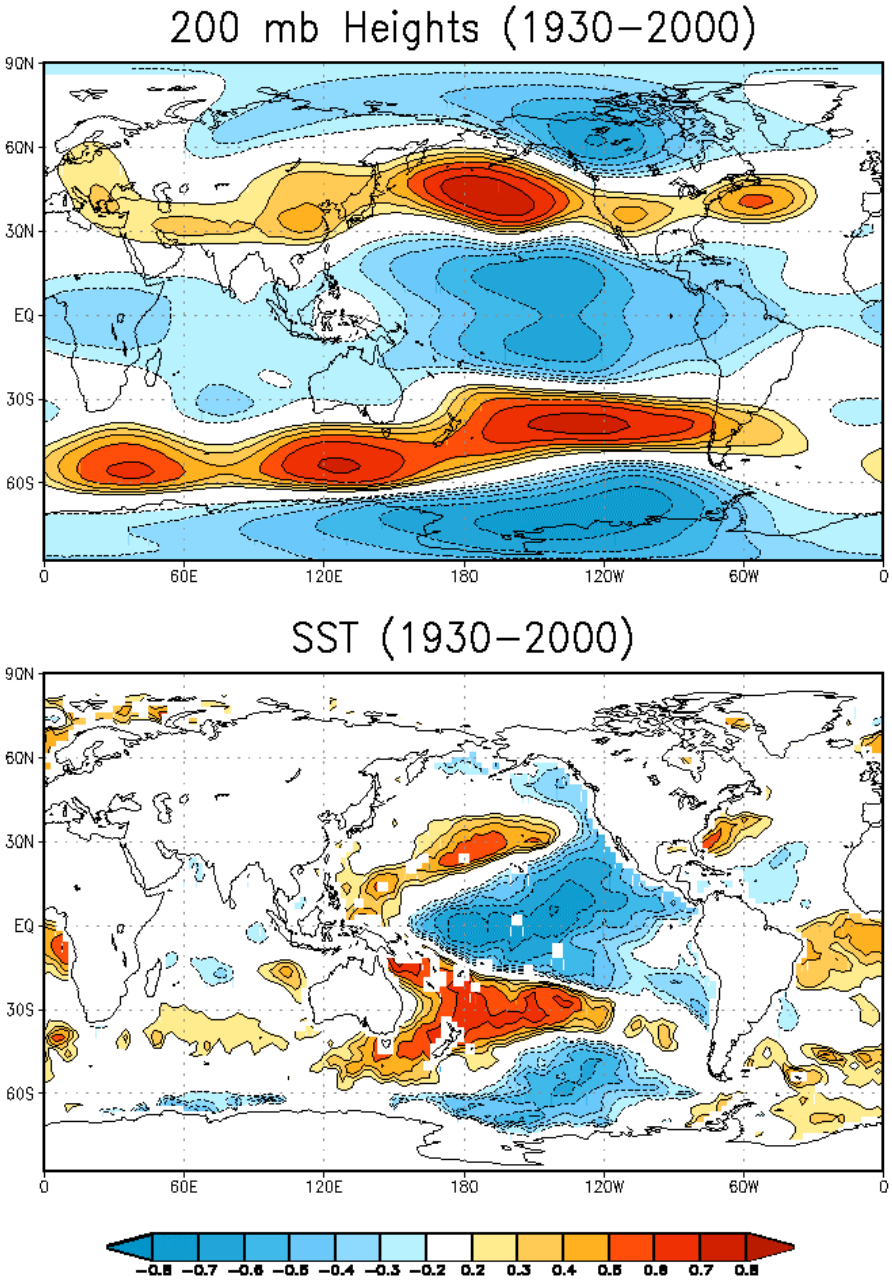

Figure 1: The negative of the correlation between the low-pass filtered ensemble mean simulated precipitation anomalies over the Great Plains and 200mb height (top panel), and SST (bottom panel) for the period 1930-2000.